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(54) Vehicle access safety device

(57) An access safety device is mounted on the floor 14 of each carriage 10 of a railway train below each of the access openings 11 of individual carriages. The safety device comprises a treadle 20 for movement between a retracted position within the vehicle and an advanced position which varies depending upon the width of the gap between each access opening 11 and the platform 60 of a railway station, a detecting means for detecting the gap width, an interlocking mechanism for moving the treadle 20 between the advanced and retracted positions, and an adjusting mechanism for adjusting the amount which the treadle 20 advances so as to compensate for variations in the width of such gaps.

FIG. 1

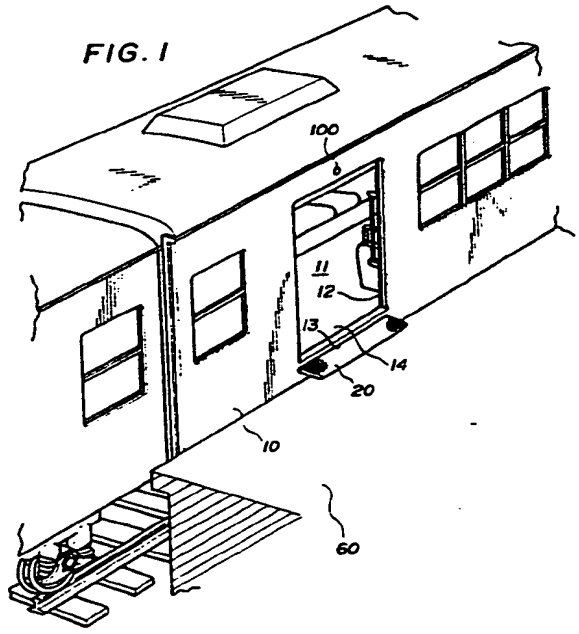

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FIG. 1

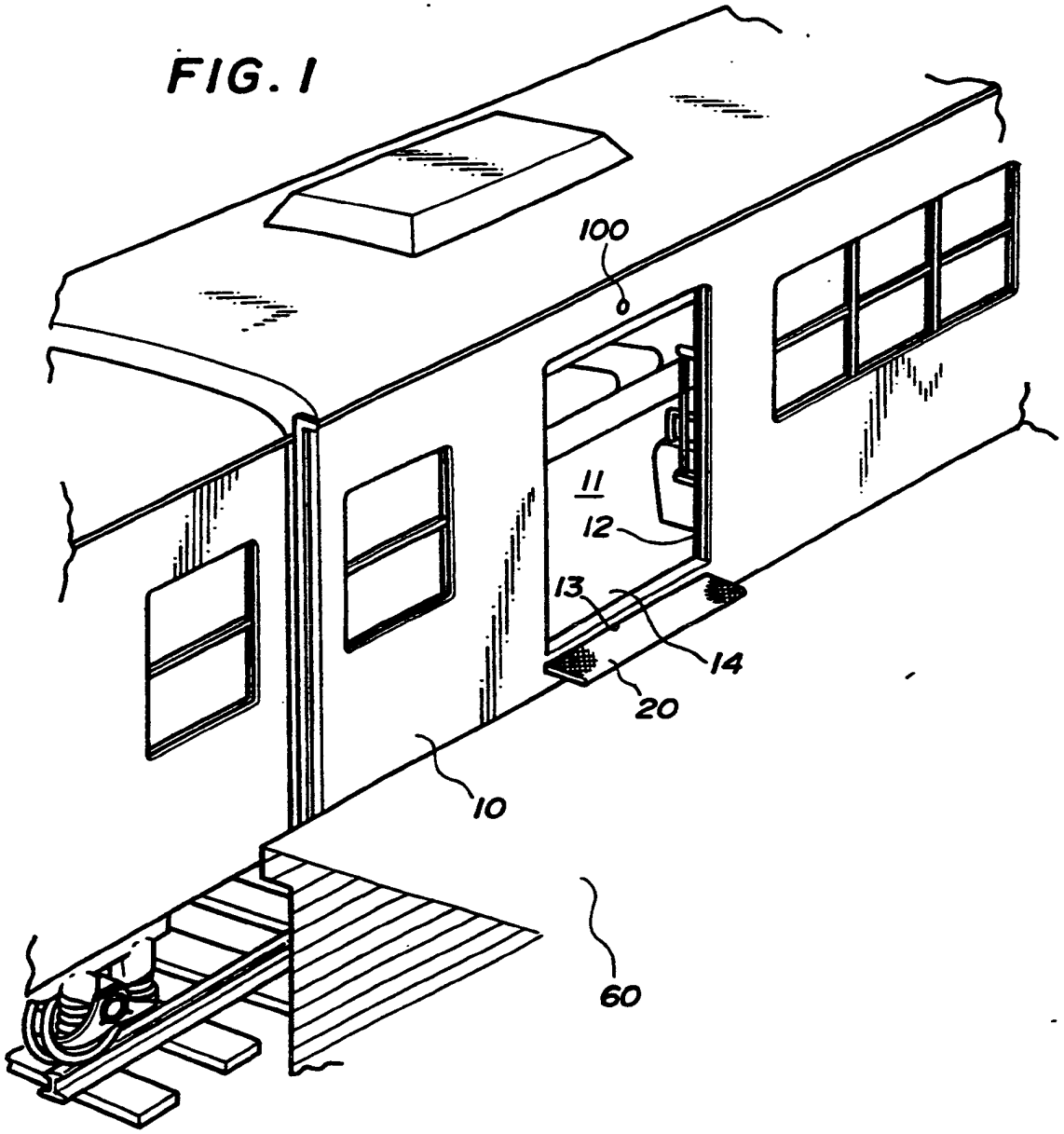


FIG. 2

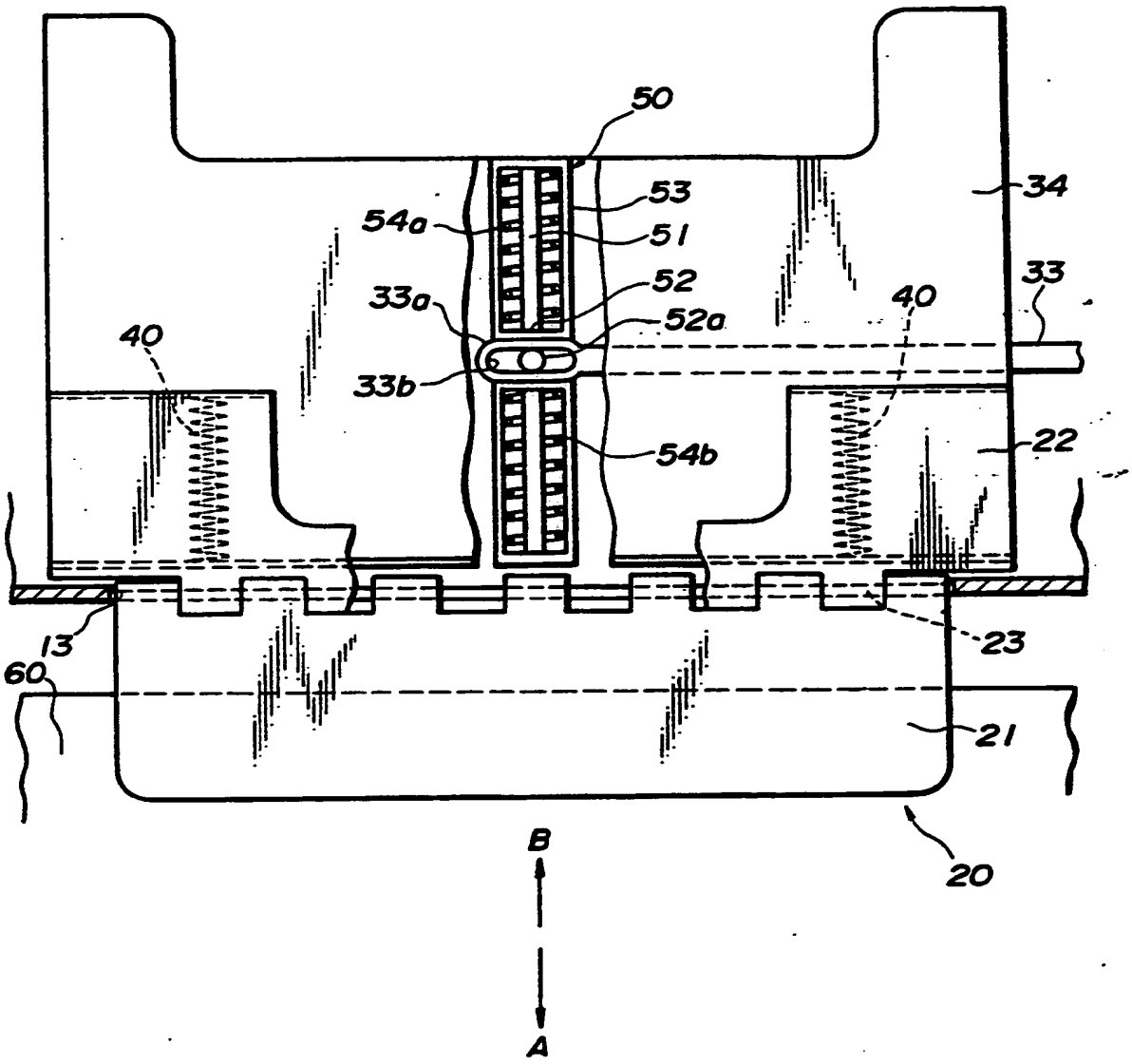


FIG. 3

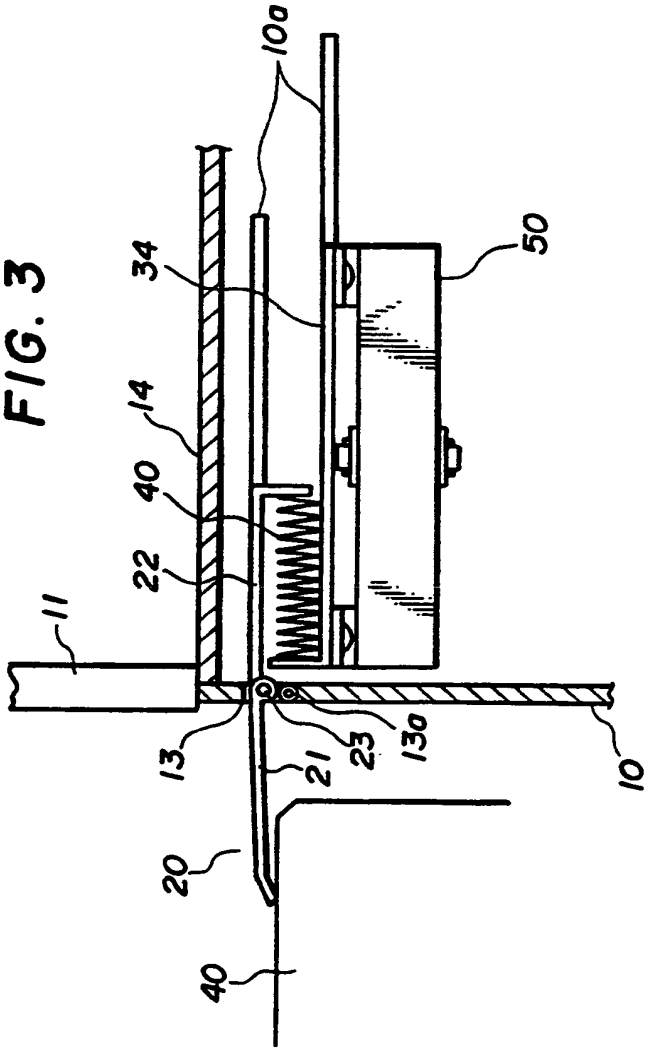


FIG. 4

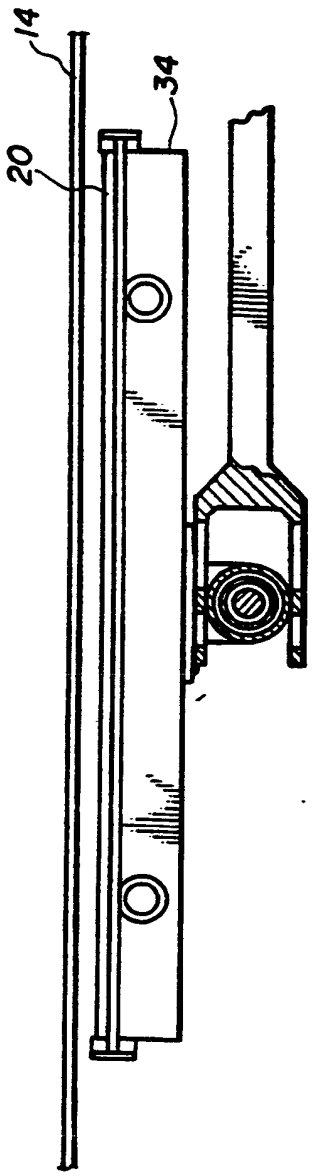
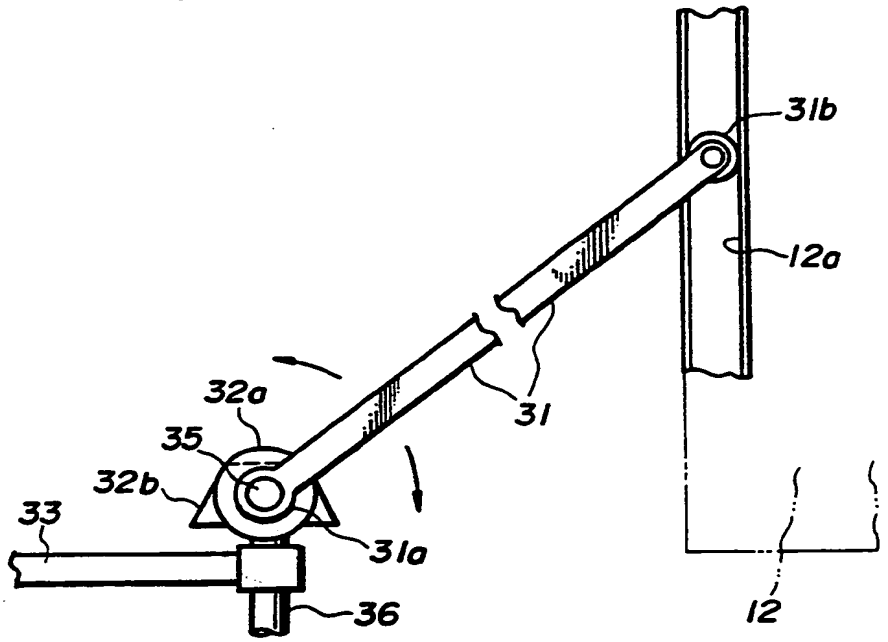


FIG. 5



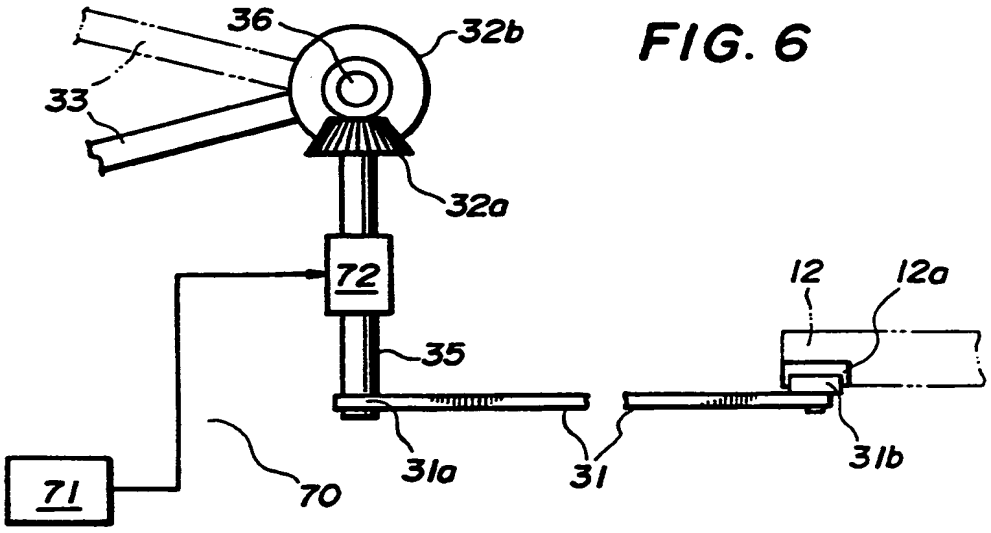


FIG. 6

FIG. 7

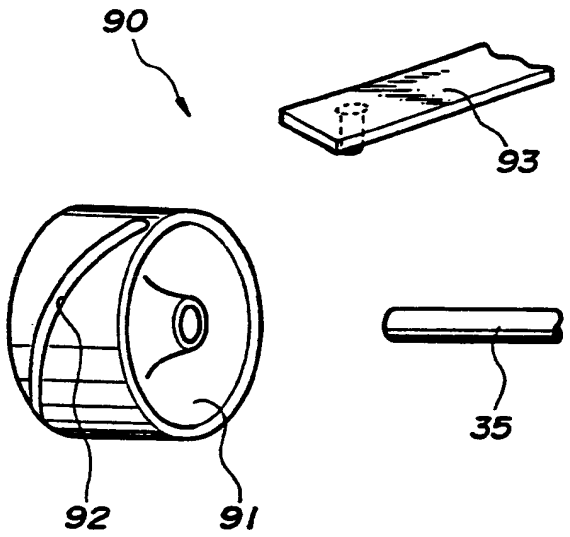
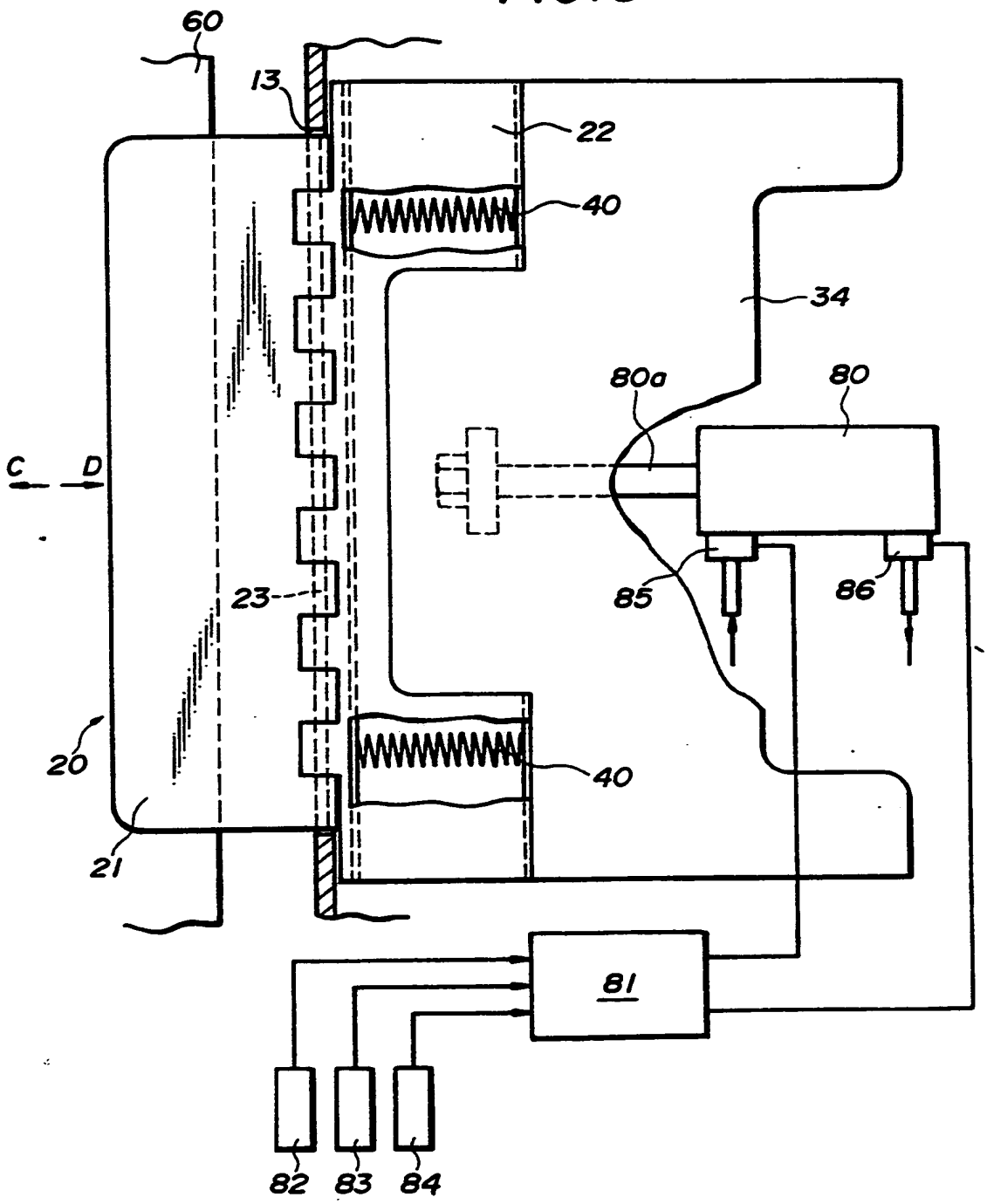


FIG. 8



VEHICLE ACCESS SAFETY DEVICE

This invention relates to a vehicle access safety device provided at each of the access openings in each of the carriages of a train to prevent passengers from falling into the gap between the access openings of the carriages and a railway platform when the passengers board and alight from the train.

A gap frequently exists between the access openings of the carriages of a train, such as a tram car or monorail train, and the platform of a railway station. This gap is especially great when the platform has an acute curvature. Such a gap between carriages and a sharply curved railway platform is dangerous to passengers, especially to children and aged and disabled persons because the passengers may step or fall into the gap.

Proposals have been made in the past with a view to preventing such hazards in the form of vehicle access safety devices which are arranged to span the gap in response to the opening action of the doors of a train with the aid of a treadle.

However, the gap between individual carriages and the railway platform is not constant, varying in accordance with the degree of curvature of the platform. In the previously proposed safety devices, the amount by which a treadle advances is constant. Thus, the prior art safety device cannot accommodate variations in the curvature of a railway platform and thus cannot ensure perfect safety.

The present invention has as its object the

elimination of the problems inherent to the prior art access safety devices described above and provides a vehicle access safety device which can vary the amount which the treadle advances to accommodate various degrees of curvature of railway platforms.

In order to attain this object, in the case of the access safety device of the present invention, a retractable treadle is provided below the floor at each of the access openings of the carriages of a railway train for movement between a retracted position within the vehicle body and an advanced position projecting from the vehicle which varies in accordance with the dimension of the gap between the access opening and the platform of a railway station, an interlocking mechanism is provided for advancing and retracting the treadle in response to the opening and closing action of each door, buffer means are provided to prevent application of any excessive force on the interlocking mechanism, and an adjusting mechanism is provided to enable the amount which the treadle advances to be adjusted in accordance with the dimension of the gap between the access opening and the railway platform.

The adjusting mechanism is adapted to detect the dimension of the gap between the platform and the access openings in each of the carriages constituting a railway train and to control the interlocking mechanism based on a detection signal.

Thus, when a train stops at a railway station and the conductor on the train unlocks the control system associated

withe the carriage access openings on the side facing the railway station platform, the adjusting mechanism of the safety device for each access opening on that side detects the width of the gap between the access opening and the platform of the railway station and controls the interlocking mechanism based on the detected gap width to cause the treadle to advance by a corresponding amount so that the treadle properly spans the gap.

According to the present invention, there is provided a vehicle access safety device which comprises a treadle mounted below the floor at the access openings of each of the individual carriages of a railway train for movement between retracted and variable advanced positions and an interlocking mechanism provided between said treadle and each of the doors in the carriages for moving said treadle between said retracted and advanced positions and including buffer means, the safety device being characterized by the provision of an adjusting mechanism enabling the amount which the treadle advances to be adjusted so as to compensate for variations in the width of the gap between the associated access openings and the platform of a railway station.

The above and other objects and attendant advantages of the present invention will be more readily apparent to those skilled in the art from a reading of the following detailed description in conjunction with the accompanying drawings, which show preferred embodiments for illustration purposes only, and not for the purpose of restricting the

scope of possible embodiments of the present invention in any way.

Fig. 1 is a perspective view showing the safety device of the present invention mounted on one of the individual carriages of a railway train;

Figs. 2 through 6 show a first embodiment of the safety device of the present invention wherein Fig. 2 is a plan view on an enlarged scale of the retractable treadle of the safety device with a portion thereof cut away; Fig. 3 is a side elevational view of the treadle shown in Fig. 2, Fig. 4 is a front elevational view of the treadle shown in Fig. 2, Fig. 5 is a side elevational view showing the relationship between the access opening associated with the inventive safety device and the vertically rockable arm of the safety device, and Fig. 6 is a plan view of the interlocking mechanism and treadle advancing amount adjusting mechanism in the safety device with a portion thereof cut away;

Fig. 7 is an exploded perspective view of another interlocking mechanism; and

Fig. 8 is a plan view of a second embodiment of the safety device of the present invention with a portion thereof cut away.

The present invention will now be described referring to the accompanying drawings and, more particularly, to Fig. 1 in which the access safety device of the present invention is shown as being mounted on one of individual carriages of a railway train. In Fig. 1, 10 denotes the

carriage which has a plurality of access openings 11, 11 ... in which automatically opening and closing doors 12, 12 operable under air or oil pressure are provided. Immediately below each access opening 11 is provided a horizontal opening 13 through which a retractable treadle 20 to be described later advances and retracts. Although an access safety device of the invention is provided for each access opening 11, the following explanation refers only to the safety device associated with one access opening and this explanation is of course applicable to the safety devices associated with the other access openings.

The retractable treadle 20 is normally disposed below the floor 14 of the carriage 10 in the area adjacent to the access opening 11 (in the retracted position), and is operatively connected by means of an interlocking mechanism 30 (see Figs. 5 and 6) to the associated automatically opening and closing door 12 so that the treadle advances and retracts through the associated horizontal opening 13 as the associated door 12 opens and closes.

As more clearly shown in Fig. 2, each treadle 20 comprises a front portion 21 adapted to project outwardly from the associated opening 13 and a base portion 22. The front portion 21 is rotatably connected to the leading end of the base portion 22 by means of a transverse support shaft 23. Thus, when the treadle 20 extends or advances onto the platform 60 of a railway station, the front portion 21 rotates relative to the base portion 22 about the support shaft 23 to abut against the upper surface of the platform

60. In addition, each horizontal opening 13 is provided with a transverse roller 13a (see Fig. 3) so that the treadle 20 can advance and retract smoothly.

The interlocking mechanism 30 comprises a vertically rockable arm 31 (Figs. 5 and 6) adapted to vertically rock in response to the opening and closing action of the door 12, a bevel gear mechanism 32 adapted to change the rotational direction of the base end 31a of the vertically rockable arm 31 (Fig. 6), a transversely rockable arm 33 (see Figs. 2, 3 and 4) adapted to be rocked by the bevel gear mechanism 32 and a movable board 34 (Figs. 2, 3 and 4) adapted to move as the transversely rockable arm 33 rocks.

As more clearly shown in Fig. 5, the vertically rockable arm 31 is rotatably supported at the base end 31a on the frame of the carriage and has at the free end a roller 31b guided in an upright guide groove 12a at one side edge of the door 12. Thus, as the door 12 opens and closes, the roller 31b moves downwardly and upwardly within the guide groove 12a whereby the vertically rockable 31 rocks about the base end 31a which serves as a fulcrum so as to rotate a horizontal shaft 35 supporting the base end 31a.

The bevel gear mechanism 32 comprises a bevel gear 32a at one end of the horizontal shaft 35 and a bevel gear 32b at the upper end of an upright shaft 36 and is adapted to change the rotational direction of the horizontal shaft 35 as the vertically rockable arm 31 rocks and transmits the rotational movement of the shaft 35 in the changed direction to the upright shaft 36.

Further, the transversely rockable arm 33 is fixedly secured at the base end to the upper end of the upright shaft 36 and transversely rocks as the upright shaft 36 rotates. The free end of the transversely rockable arm 33 is formed with a connecting portion 33a having a slot-shaped engaging groove 33b (Fig. 2).

The movable board 34 is movably mounted on the vehicle frame 10a through a roller (not shown) in a position below the floor 14 (see Fig. 3). The treadle 20 is disposed on the upper surface of the movable board 34 and a second buffer means 50 is fixedly secured to the undersurface of the movable board 34 in a central portion thereof. The treadle 20 is disposed on the movable board 34 for movement in the directions of arrows A and B. A coiled spring or first buffer means 40 is interposed between the treadle 20 and second buffer means 50. The buffer means 50 comprises a guide shaft 51 extending in the directions A, B as seen in Fig. 2, a movable piece 52 moving along the guide shaft 51 and springs 54a, 54b interposed between the movable piece 52 and a case 53. The movable piece 52 has a pin 52a projecting therefrom and the pin 52a engages the connecting portion 33a of the transversely rockable arm 33. When the transversely rockable arm 33 rocks, the rocking movement of the arm 33 is converted into a linear movement by the translating mechanism constituted by the connecting portion 33a and pin 52a whereby the movable board 34 moves in the directions A and B as shown in Fig. 2.

As more clearly shown in Fig. 6, a treadle advancing

amount adjusting mechanism 70 is provided on the above-mentioned interlocking mechanism 30 for adjusting the amount which the treadle 20 advances. The adjusting mechanism 70 comprises a sensor 71 for detecting the gap between the access opening 11 and the railway platform 60 by optical means and clutch means 72 for interrupting transmission of rotational movement from the vertically rockable arm 31 to the bevel gear mechanism 32 based on a detection signal from the sensor 71.

In Fig. 1, reference numeral 100 denotes an alarm buzzer which issues an acoustic alarm when the door 12 opens and closes. The buzzer 100 serves to give a warning, especially to blind persons, about the position of the access opening 12 and also to caution them in their movement.

When the train constituted by the individual carriages arrives at a railway station and stops there, the conductor on the train unlocks the control system (not shown) associated with the doors for the access openings on the side of the train facing the railway platform 60 to allow all the doors 12 on that side of the train to open automatically whereupon the vertically rockable arm 31 associated with each door 12 rocks vertically in response to the opening movement of the doors 12 for the respective openings 11. As the vertically rockable arm 31 rocks, the horizontal shaft 35 at the lower end 31a of the arm 31 rotates. The rotational movement of the horizontal shaft 35 changes direction through the action of the bevel gear mechanism 32 and is then transmitted to the vertical shaft

36 to rotate the shaft 36. As the upright shaft 36 rotates, the transversely rockable arm 33 rocks and the rocking movement of the arm 33 is translated into a lin ar movement by the connecting portion 33a and pin 52a to move the movable board 34 in the direction A as seen in Fig. 2 (towards the access opening 11). Thus, the treadle 20 advances through the horizontal opening 13 to span the gap between the access opening 11 and the platform 60 so that passengers can safely set on and off the train.

The amount which the treadle 20 advances is previously set to compensate for the anticipated maximum gap width between the access opening 11 and the railway platform 60, but if the actual gap is smaller than the anticipated maximum value, the adjusting mechanism 70 operates. That is, when the vehicle stops by the railway platform 60, the sensor 71 detects the gap width. If it is detected that the gap width corresponds to the preset advancing amount for the treadle 20 to advance, the sensor 71 outputs a detection signal to the clutch means 72 which in turn interrupts transmission of the rotational movement from the vertically rockable arm 31 to the bevel gear mechanism 32 so that the treadle 20 is prevented from advancing beyond the detected gap width.

When the treadle 20 strikes against any obstacle in its advancing movement, the first buffer means or spring 40 absorbs the movement of the movable board 34 and the second buffer means 50 or springs 54a, 54b absorb the rocking movement of the transversely rockable arm 33 to prevent

application of any excessive force to the interlocking mechanism 30.

When the door 12 automatically closes, the treadle 20 is caused to retract within the carriage 10 through the opening 13 by the interlocking mechanism 30.

It is to be noted that the bevel gear mechanism 32, upright shaft 36 and transversely rockable arm 33 in the embodiment illustrated and described above may be replaced by a cam mechanism 90 whereby the rotational movement of the horizontal shaft 35 is translated into a linear movement to move the movable board 34 as shown in Fig. 7. That is, when the carriage 10 stops by the railway platform 60, the sensor detects the gap width between the access opening 11 and the platform 60 and outputs a detection signal to the clutch means 72 which in turn interrupts the transmission of rotational movement from the vertically rockable arm 31 to the bevel gear mechanism 32 so that excessive advance of the treadle 20 is prevented.

When the treadle 20 strikes against any obstacle in its advancing movement so that the advance of the treadle is hindered, the first buffer means or spring 40 absorbs the movement of the movable board 34 whereas the second buffer means or springs 54a, 54b absorb the rocking movement of the transversely rockable arm 33. Thus, the application of any excessive force to the interlocking mechanism 30 is prevented.

When the door 12 automatically closes, the treadle 20 is caused to retract into the carriage 10 through the opening 13 by the interlocking mechanism 30.

The bevel gear mechanism 32, upright shaft 36 and transversely rockable arm 33 in the embodiment illustrated and described above may be replaced by a cam mechanism 90 as shown in Fig. 7 so that the rotational movement of the horizontal shaft 35 is translated into a linear movement to thereby move the movable board 34. The cam mechanism 90 comprises a columnar member 91 mounted on the horizontal shaft 35 for rotation therewith and having a spiral cam groove 92 formed about the outer periphery of the member 91. A follower member 93 fixedly secured to the movable board 34 engages in the spiral groove 92. With this arrangement, when the door 12 opens and closes, the vertically rockable arm 31 rocks in response to the opening or closing operation of the door to rotate the horizontal shaft 35 and columnar member 91 which in turn moves the follower member 93 linearly in one or the opposite direction along the axis of the columnar member 91 whereby the movable board 34 is caused to move in the direction A or B, as shown in Fig. 2.

Also in this case, the clutch means 72 of the adjusting mechanism 70 adjusts the rotational angle of the columnar member 91 or the initiation time of rotation of the member to thereby adjust the movement range of the follower member 93 and, accordingly, the advancing amount of the treadle 20 can be adjusted.

Fig. 8 shows a second embodiment of the access safety device according to the present invention. In the second embodiment, the interlocking mechanism 30 and advancing amount adjusting mechanism 70 in the first embodiment are

replaced by a single hydraulic cylinder 80 which is controlled by a controller 81 constituted by a microcomputer.

The controller 81 is connected to a sensor 82 adapted to sense when the access door 12 opens, a sensor 83 adapted to sense when the door 12 closes and a sensor 84 adapted to detect the gap width between the respective openings 11 and the railway platform 60 by optical means (not shown), and when the controller 81 receives detection signals from these sensors 82, 83, 84, the controller outputs control signals to flow rate control valves 85, 86 provided on pressurized oil inlet and outlet ports of the hydraulic cylinder 80.

The operation of the second embodiment of the vehicle access safety device will now be described.

As described above in connection with the first embodiment, the conductor on the train unlocks the control system (not shown) associated with the doors on the side of the train facing the railway platform 60 to allow all the doors 12 on the said side of the vehicles to open automatically. As the doors 12 associated with each of the access openings 11 begin to open, the sensor 82 senses the opening action of each door 12 and feeds a detection signal to the controller 81 which in turn feeds control signals to flow rate control valves 85, 86 whereby the hydraulic cylinder 80 operates to advance its drive shaft (piston rod) so as to move the movable board 34 in the direction of arrow C shown in Fig. 7. At this time, a detection signal representing the gap width between the access opening 11 and railway platform 60 is output from the sensor 84 to

the controller 81 and thus, the amount which the drive shaft 8a is to advance (i.e. the amount which the movable board 34 is to move in the direction C) is controlled so as to correspond to the actual gap width and, thus, the treadle 20 advances by an amount sufficient to span the gap so that passengers can safely get on and off the train 10.

When the treadle 20 strikes against any obstacle in its advancing movement and further advance of the treadle is inhibited, the first buffer means or spring 40 absorbs the movement of the treadle 20 to thereby prevent any excessive force from being applied to the hydraulic cylinder 80.

When the door 12 closes, the sensor 83 detects the closing action of the door and feeds a detection signal to the controller 81 which in turn feeds a control signal to the flow rate control valves 85, 86 so that the drive shaft 80a is retracted to move the movable board 34 in the direction of arrow D so as to cause the treadle 20 to retract through the horizontal opening 13 into the carriage 10.

As described hereinabove, according to the present invention, since the vehicle access safety device includes an adjusting means adapted to adjust the amount which the treadle advances in conformity with the gap between each access opening and the railway platform 60, the device represents an improvement in terms of safety over the prior art safety devices.

While preferred embodiments of the invention have been shown and described in detail, it will be understood

that the same are for illustration purpose only and not to be taken as a definition of the invention, and reference should be given to the appended claims for that purpose.

CLAIMS

1. A vehicle access safety device comprising a tread mounted adjacent a door access opening below the floor of a carriage of a railway train, for movement between a retracted and variable advanced position and an interlocking mechanism provided between said tread and the or each adjacent door of the carriage for moving said tread between said retracted and advanced positions in response to the opening and closing action of the door or doors and including buffer means, wherein an adjusting mechanism is provided for adjusting the amount by which said tread advances so as to compensate for variations in the width of gaps between the associated access opening and the platforms of railway stations.

2. A vehicle access safety device as set forth in Claim 1 wherein said interlocking mechanism comprises a vertically rockable arm for rocking in response to the opening and closing action of the associated door, a bevel gear mechanism at the base of said rockable arm for changing the rocking movement direction of the arm, a transversely rockable arm for causing rocking movement of said vertically rockable arm through said bevel gear mechanism and a movable board for movement as said transversely rockable arm rocks.

3. A vehicle access safety device as set forth in Claim 2 wherein a horizontal shaft is provided at the base end of said vertically rockable arm about which the vertically rockable arm rotates.

4. A vehicle access safety device as set forth in Claim 3 wherein said bevel gear mechanism comprises

a first bevel gear at one end of said horizontal shaft and a second bevel gear provided at the upper end of an upright shaft and meshing with said first bevel gear.

5. A vehicle access safety device as set forth in Claim 4 wherein said transversely rockable arm is secured at the base end to said upright shaft for rotation together with the shaft and has at the free end a connection portion with a slot-like engaging groove.

6. A vehicle access safety device as set forth in any one of Claims 2 - 5 wherein said movable board is movably mounted on the floor of said vehicle, said tread is mounted on the upper surface of said movable board, first buffer means is secured to the undersurface of said movable board at a central area thereof and second buffer means is interposed between said tread and the movable board.

7. A vehicle access safety device as set forth in Claim 2 wherein said adjusting mechanism comprises a sensor for optically detecting the actual gap width between each access opening and the adjacent railway platform and clutch means for interrupting transmission of rotational force from said vertically rockable arm to said bevel gear mechanism based on a detection signal from said sensor.

8. A vehicle access safety device substantially as described herein with reference to Fig. 1 - 6 or Fig. 1 - 6 as modified by Fig. 7 or Fig. 8 of the accompanying drawings.

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